CLAIMS

Having described the invention, what is claimed is:

1. A method of forming a workpiece with a shaped surface having at least a portion that is axially asymmetric, the method comprising the steps of:

providing a slow tool servo assembly having a tool assembly and a spindle assembly, the spindle assembly securing said workpiece and being rotatable about an axis of rotation, the tool assembly having a first x-axis linear drive for moving said tool assembly in an axis orthogonal to the spindle axis of rotation, a second z-axis linear drive for moving said tool assembly in an axis parallel to the spindle axis of rotation, a tool and an encoder to provide angular position feedback of the tool relative to the workpiece;

rotating the spindle assembly between 30 revolutions per minute and 200 revolutions per minute;

positioning the tool in contact with the workpiece; and

oscillating the tool assembly transversely and longitudinally with respect to the workpiece surface to selectively remove portions of the workpiece to form the axially asymmetric portion of the workpiece surface by controlling the location of a contact point of the tool and workpiece along the axis parallel to the spindle axis of the rotation, the contact point location being a function of the location of the contact point along an x-axis and a function of the angle of rotation of the spindle about the spindle axis.

2. The method of claim 1, wherein the slow tool servo assembly further comprises a controller having a processor and wherein the method further comprises the steps of:

inputting a formula to the processor corresponding to a desired shape for a workpiece surface;

simultaneously measuring the relative angle of rotation of the spindle about the spindle axis, and the relative transverse linear location of at least one of the contact point and working tool; and

processing the inputted formula, using the measured angle of rotation and the x-axis contact point location, to determine the necessary z-axis location of at least one of the workpiece surface and tool.

3. The method of claim 1, further comprising the steps of:

predetermining a slope and orientation of the workpiece surface at a specific location; and

generating a command signal to rotate a table upon which the tool assembly is mounted, the table rotating about a b-axis orthogonal to the x-axis and z-axis to maintain perpendicularity of the tool relative to the workpiece surface.

4. The method of claim 1, wherein the tool is a grinding wheel.

5. The method of claim 1, wherein the tool is a single point diamond cutting tool.

6. An apparatus for forming an axially asymmetric portion of a workpiece surface, the apparatus comprising:

a spindle assembly having a rotable spindle for holding the workpiece, the spindle being selectively rotatable about an axis of rotation; and

a tool assembly having a tool for contacting the workpiece, a first x-axis linear drive for moving said tool assembly in an axis parallel to the spindle axis of rotation, a second z-axis linear drive for moving said tool assembly in an axis orthogonal to the axis of the first linear drive, and an angular rotation sensor to provide angular position feedback of the tool relative to the workpiece.

7. The apparatus of claim 6, wherein the angular position sensor is coupled to the spindle to detect the angle of rotation of the spindle.

8. The apparatus of claim 6, wherein the angular position sensing means is a rotary encoder.

9. The apparatus of claim 6 wherein the tool assembly further comprises a table, the table being movable along the x-axis and z-axis through the first x-axis linear drive and the second z-axis linear drive.

10. The apparatus of claim 9 wherein the tool is mounted to the table of the tool assembly.

11. The apparatus of claim 10 wherein the table is rotatable about an axis of rotation orthogonal to said x-axis and z-axis, the rotatable table being operably configured to maintain a substantially perpendicular relationship between the tool and said workpiece surface.

12. The apparatus of claim 11 wherein the tool assembly is a diamond turning machine.

13. The apparatus of claim 11 wherein the tool assembly is a grinding machine.

14. The apparatus of claim 6 wherein the apparatus for forming an axially asymmetric portion of a workpiece surface further comprises a controller for controlling at least one of said first x-axis linear drive, second z-axis linear drive and the relative angular rotation of the rotary table.

15. An apparatus for forming an axially asymmetric portion of a workpiece surface, the apparatus comprising:

a spindle assembly having a rotable spindle for holding the workpiece, the spindle being selectively rotatable about an axis of rotation;

a tool assembly having a tool for contacting the workpiece, a first x-axis linear drive for moving said tool assembly in an axis parallel to the spindle axis of rotation, a second z-axis linear drive for moving said tool assembly in an axis orthogonal to the axis of the first linear drive, and an angular

rotation sensor to provide angular position feedback of the tool relative to the workpiece; and

a processor for receiving the angular position feedback and x-axis position of the tool and determining a z-axis position for the tool.

16. The apparatus of claim 15 wherein the tool assembly further comprises a table and the tool is mounted to the table, the table being movable along the x-axis and z-axis through the first x-axis linear drive and the second z-axis linear drive, the table further being rotatable about an axis of rotation orthogonal to said x-axis and z-axis to maintain a substantially perpendicular relationship between the tool and said workpiece surface.

17. The apparatus of claim 16 wherein the tool assembly is a diamond turning machine.

18. The apparatus of claim 16 wherein the tool assembly is a grinding machine.

19. The apparatus of claim 16 wherein the controller the relative angular rotation of the rotary table to maintain a substantially perpendicular relationship between the tool and said workpiece surface.